in malignant gall-bladders furnishes evidence worthy of note with respect to the gall-stones acting as sources of irritation and the production of malignant hyperplasia of the gall-bladder mucosa. It is not impossible, however, that in malignant gall-bladders calculi may form as a consequence of cancerous change altering the excretory function of the gall-bladder mucosa or preventing proper emptying of the viscus. From the clinical histories of many patients who later on are shown to have malignant disease of the gall-bladder, attacks simulating gall-stones can be elicited at a time previous to the more recent ailment which is apparently clinically malignant. It would certainly seem that in patients in whom gall-stones can be proved to exist, from the clinical or special examinations, their early removal, together with the gall-bladder, might be a considerable factor in preventing malignancy in the individual and also in the human family.

4. INVOLVEMENT OF ADJACENT VISCERA. In 11 cases the lymph nodes showed metastases; in 8 cases the liver was extensively invaded; in 6 the pancreas; in 2 the stomach and in 1 case each there was extension to the omentum, the hepatic flexure of the colon and the retroperitoneal lymph tissue.

OPERATIVE PROCEDURE. In 11 patients abdominal exploration only was possible on account of extensive malignancy. In 4 cases cholecystectomy was performed and once posterior gastro-enterostomy for the relief of pyloric obstruction. In the remaining 7 patients the gall-bladder was drained.

RESULT. Two patients recovered and have remained well longer than four years. Fatal termination followed in the remainder either shortly after operation or within eight months subsequent to leaving the hospital.

THE RELATION OF PAIN IN GASTRIC AND DUODENAL ULCER TO MUSCULAR ACTIVITY OF THE STOMACH.

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SINCE the discovery by Boldireff of the presence of contractions in the empty stomach and the demonstration by Cannon that these contractions represent the so-called "hunger pangs," the subject of the activity of the fasting stomach has been most thoroughly worked out by Carlson[1] and his associates both for man and animals. The earlier work of Carlson indicated that the sensory evidence of these contractions, carried by way of the vagus system, originated in the contractions themselves, and the suggestion was made that the pain of gastric and duodenal ulcers might originate through this mechanism.

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[1] The Control of Hunger in Health and Disease, Chicago. 1916.

A number of investigations, notably by Ginsburg, Tumpowski and Hamburger[2] and by Carlson,[3] have demonstrated that the pain in a number of cases of peptic ulcer was in fact rhythmic and that the patient's record of his accessions of pain corresponded to the graphic demonstration of typical hunger contractions. The published tracings of these researches are very convincing, but in taking many histories in ulcer cases one is obliged to note that while accessions of pain are sometimes found to have a rhythmic character, often one finds that the story of pain is continuous and that no interruption or rhythmicity can be read into it. Indeed, the only cases which, for one reason or another, we were able to study at the hospital during the winter of 1916–17 were of this character. The results in this short series, therefore, without controverting the findings of others, seem to show that pain in patients suffering from proved, active, gastric and duodenal ulcers is not of necessity associated with any recognizable activity of the gastric walls and that intense gastric activity can occur in these same patients without giving rise to pain.

The method of study was that of Carlson: the use of a soft, thin-walled rubber bag, readily swallowed and connected to a water manometer of great delicacy by a fine, soft rubber tube. The float of the manometer was made to write without the interposition of a lever upon the slow kymograph. The patient indicated painful sensations by an electric signal. Before the work on ulcer patients was undertaken a year's work on dogs and a study of other human cases had made the method thoroughly familiar.

CASE I.—P. B. Surgical 5941. Aged sixty years. Acute gastric ulcer. Symptoms of only twenty days' duration previous to these observations.

Previous History. Unimportant. No previous gastro-intestinal symptoms noted.

Present Illness. Twenty days before the patient began to have high epigastric pain coming on one-half to one hour after eating. At times the same pain comes at night. It is severe, dull, continuous and felt often as a radiation into the right chest and back. Vomiting, at irregular intervals, of coffee-ground material. No retained food. Slight relief from vomiting, but, on the whole, pain is nearly continuous, with short, slight food relief.

Physical Examination. Somewhat emaciated man, drowsy and in pain. Questionable mass in epigastrium.

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[2] Contributions to the Physiology of the Stomach XXXV: The Newer Interpretation of Gastric Pain in Ulcer, Jour. Am. Med. Assn., 1916, lxvii, 990.

[3] The Origin of the Epigastric Pain in Cases of Gastric and Duodenal Ulcer, Am. Jour. Physiol., 1917, xlv, 81.

Gastric Analysis. Fasting contents, 50 c.c. Free HCl, 25 c.c. Total acidity, 46 c.c. Test meal: at end of forty minutes: Free HCl, 76 c.c.; total acidity, 44 c.c. At end of eighty minutes: Free HCl, 26 c.c.; total acidity, 40 c.c. At end of 120 minutes: Free HCl, 14 c.c.; total acidity, 34 c.c. Last two specimens bile-stained. Evidently continuous acidity.

Roentgen Study. Large smooth defect in posterior gastric wall just below the lesser curvature, half-way from the pylorus to the cardia. No stasis.

Motility Study I. December 19, 1916. Sixteen hours after eating. Observation for one and one-half hours. Continuous slight epigastric pain of the kind usual to the patient. Low tonus, with slight variations, but no contractions.

FIG. 1.—Case I. Gastric ulcer. Onset of pain is indicated by cessation of time marker. Digestion peristalsis of low grade is shown. Diminution rather than increase of this peristalsis with onset of pain. Low tonus. Base line should be about 1.5 cm. above time marking line. Five-second marking.

Motility Study II. December 20. Two hours after eating. Observation for one and three-quarter hours. Comfortable for three-quarter hour. Moderate gastric tonus with some evidence of short digestive rhythm. Some epigastric pain ushered in by a painful period of about fifteen seconds, followed by a free interval of thirty seconds. After this pain was continuous. No contractions or notable variation in tonus for one hour (Fig. 1). The pain signal was given by interrupting the time-marking apparatus. Base line not indicated. (It should have been about 1.5 cm. above the time line.)

At operation a penetrating ulcer just below the lesser curvature in the mid-stomach was found. It was adherent to the pancreas, was unhealed and surrounded by a narrow inflammatory zone.

Summary of Case I. Acute gastric ulcer. Study made on fasting stomach shows habitual slight pain without contractions. Study made after eating shows severe pain accompanied by low tonus without contractions.

Case II.—W. C. C. Aged twenty-eight years. Surgical 5992. Chronic gastric ulcer. Symptoms of twelve years' duration.

Previous History. Unimportant.

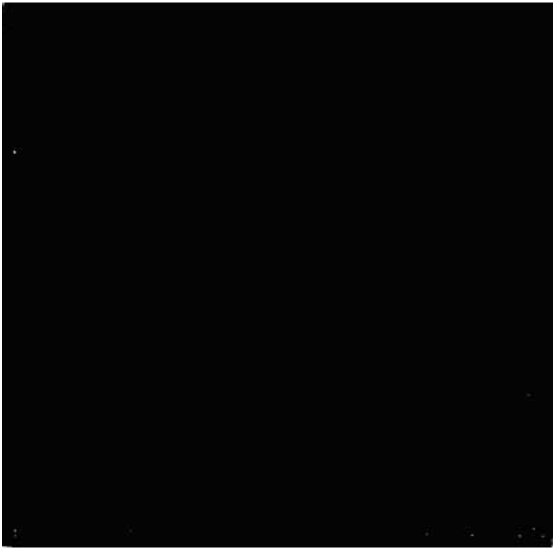

Fig. 2.—Case II. Gastric ulcer. Vigorous hunger contractions (empty stomach) without pain. Oscillation at x is due to a cough. Half-minute marking.

Present Illness. Beginning twelve years ago, distress and "weakening feeling" coming on after meals, with pain in the lower abdomen coming on early after meals or in one or two hours. Typical remissions (one of eighteen months). For five years, dull, grinding epigastric pain at night. Sour eructations. Relief from vomiting, soda and passing of gas by the rectum. Pain now situated a little above the umbilicus and radiates to sides and back.

Physical Examination. Unimportant.

Gastric Analysis. Fasting contents: Eight to ten drops, showing free HCl (not titrated), benzidine +++. Test meal: At the end of forty minutes: Free acid, 29 c.c.; total acidity, 50 c.c. At the end of 120 minutes: Free acid, 54 c.c.; total acidity, 72 c.c. At the end of 160 minutes: Free acid, 60 c.c.; total acidity, 76 c.c. Increasing acidity for nearly three hours after test meal. Continuous acidity.

Roentgen Study. Deep niche in lesser curvature. Slightly hypotonic dilated stomach. Pylorus and duodenum negative. Emptying in four hours.

FIG. 3.—Case II. Gastric ulcer. Same day as Fig. 2, but after eating full meal. Note vigorous digestion peristalsis up to point marked *S. P.* Here severe pain suddenly began. At point *x* patient made sudden movements, interrupting otherwise nearly level record. Note diminution of respiratory excursion after onset of pain. Tension of balloon lowered and again raised without altering pain. Half-minute marking.

Motility Study I. December 27, 1916. Fourteen hours after eating. Observation for three hours. Typical hunger contractions, of which Fig. 2 gives an adequate idea. They occurred in two periods, were unusually vigorous and were not accompanied by any pain whatsoever nor by any sensation by which the patient could recognize them.

Motility Study II. December 27. Same day as the preceding study. Two hours after a hearty meat dinner (12.30 P.M.). Swallowed bag at 2.15 P.M. Observation for three hours. Until 4 P.M., *i. e.*, three hours after eating, tracings showed digestion peristalsis (twenty second rhythm of variable intensity), with fairly high tonus, and no pain was noted. Patient asleep, lying on left side, until pain began at about 4 P.M. and waked patient up. It was of the usual dull, grinding character and caused the patient to writhe, interrupting diaphragmatic breathing, as shown by the diminished respiratory excursions of the manometer needle. Aside from small oscillations, due to body movements, the indicator recorded no gastric activity. On turning the patient upon his right side, the pain ceased in ten minutes, recurred again for a brief period, and as it disappeared the patient passed gas freely by the rectum and gastric motility returned (Fig. 3).

Operation. January 3, 1917. An open penetrating ulcer near the lesser curvature was found. Considerable area of induration about it. Adherent to pancreas. Excision of ulcer. Posterior gastrojejunostomy.

Motility Study III. January 17 (two weeks after operation). Fourteen hours after eating. Tracings show high tonus, well-marked digestive rhythm (twenty-second contractions), which gradually developed into rather irregular hunger contractions in the course of two hours.

Summary of Case II. Chronic gastric ulcer. Powerful gastric contractions in stomach without pain. Pain after eating, coming on during a period of active digestion peristalsis, with cessation of this peristalsis during the painful period. Cessation of pain on turning the patient from the left to the right side, followed by gradual resumption of digestion peristalsis.

CASE III.—C. W. S. Aged forty-three years. Surgical 6521. Chronic duodenal ulcer. Symptoms of eighteen years' duration.

Previous History. Unimportant.

Present Illness. Typical, twice a year, the periods of pain coming on regularly about three hours after eating. Pain in the nature of a severe soreness, as of "something squeezing by raw surface;" it always was felt under the edge of the ribs on the right. Marked night pain. Clean-cut food and soda gave relief.

Physical Examination. Unimportant.

Gastric Analysis. Fasting contents, 40 c.c.: Free HCl, 60 c.c. Total acidity, 78 c.c. Test meal (three forty-minute periods). On first two periods duodenal contents obtained. (No free HCl.) At the end of the third period 135 c.c. were obtained during the withdrawal of the tube. Free HCl, 70 c.c.; total acidity, 80 c.c. Apparently continuous high acidity.

Roentgen Study. Permanent irregularity of the first portion of the duodenum. Hypertonic stomach.

Motility Study I. March 31, 1917. Eight hours after eating. After swallowing the bag the patient lay on the right side and the pain began in several short periods, soon becoming continuous. During this time the gastric tonus was low and there were no contractions. When turned on the left side the pain ceased and hunger contractions began. During the period of strong hunger contractions which followed the patient experienced one painful sensation (Fig. 4) in association with an unusually weak contraction. When turned again upon his right side the contractions ceased and after one or two painful sensations steady pain set in. During the onset and establishment of pain there were no contractions and gastric tonus was very low (Fig. 4).

Operation. April 2. Puckered scar in beginning of duodenum. Mucous surface of ulcer not seen. Finney pyloroplasty.

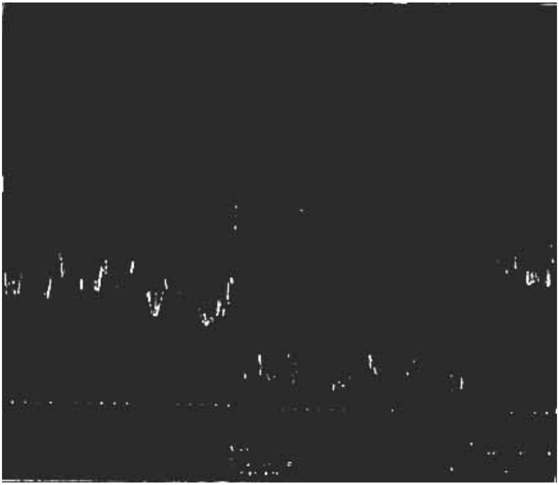

FIG. 4.—Case III. Duodenal ulcer. Fairly vigorous hunger contractions (empty stomach), which ceased on turning patient from left side to right. A moment of pain corresponded to low contraction on left of record. Pain indicated by signal on lower line (and by letter *P*). It became continuous nine minutes after turning upon the right side. Establishment of continuous pain noted by frequently depressing pain signal and then holding it down. Alterations in tension are due to changes in position. No contractions after pain began. Half-minute markings.

Motility Study II. April 22. Twenty days after operation. Twelve hours after eating. Two contraction periods seen. First period with the patient lying on his back. The second with the patient lying on his left side. This period ended soon after turning the patient upon the right side, possibly a coincidence, but interesting in connection with the preoperative study (Fig. 5). No sensations noted by the patient.

Summary of Case III. Chronic duodenal ulcer. Gastric contractions on fasting stomach without pain. Pain without gastric contractions. Apparent influence of position on pain and contractions.

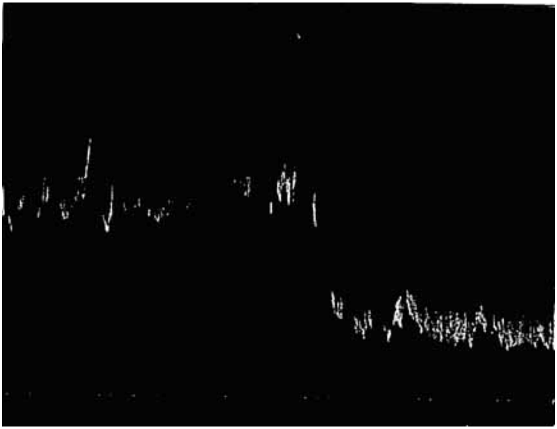

FIG. 5.—Case III. After operation. Short period of hunger contractions on rather high tonus. Cessation of period soon after turning to right side. No pain; clinically well. Compare with Fig. 4. Half-minute markings.

DISCUSSION. Taking up these cases separately, Case I falls into the class of those ulcers which give rise to pain of a continuous nature. Food relief was short and incomplete and was followed by an accession of pain which slowly died down to the previous, dull, continuous level. Such a condition has been classified by Friedman[4] as belonging to a group of cases characterized by adhesions, high acidity and prolonged pyloric spasm. According to Carlson it would again be placed as an instance of pyloric contraction in the presence of ulcer and high acidity. The absence of any recognizable contraction of the fundus would not then interfere with the interpretation of pain as due to excitation of oversensitive pain nerves tortured by active muscular contractions of the pyloric region (which are not recognized in the balloon method of study). One may therefore say there is no evidence in this case which supports the interpretation of pain as being due to muscular activity of the stomach, and, on the other hand, no evidence to oppose this hypothesis, since pyloric contraction may, in fact, have taken place, due to the acid reflex from the duodenum.

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[4] Time Relations of Gastric Pains, with Special Reference to Gastric Adhesions, AM. JOUR. MED. SC, 1916, cli, 735.

Case II, however, is difficult to explain under any hypothesis. The patient presented a typical gastric ulcer history, high continuous acidity, some "grinding" pain and on balloon study, typical powerful hunger contractions without a trace of pain. On a full stomach (the same day as that on which the hunger contractions were demonstrated) the pain came on some three hours after eating, waking the patient from a sleep, during which gastric digestion peristalsis had been quite active. As the pain appeared the gastric peristalsis ceased, the tonus was lowered and the effect was conveyed that the onset of pain had diminished gastric activity. The effect of the patient's position in bed (as in Case III) is noteworthy. The pain appeared while the patient lay on his left side, and soon disappeared, without other treatment, upon turning over upon the right side. As the pain disappeared, gastric peristalsis was resumed and tonus increased. Coincident with this relief the patient passed gas by the rectum. One might suppose, therefore, that the position of the abdominal contents, and possibly some drag on a sensitive mesenteric attachment, for which a cause might be found in the posterior penetration of the ulcer, were more concerned with the pain than the gastric activity itself. It is certainly true that intense hunger contractions caused no pain and that pain was coincident, with no demonstrable gastric contractions.

Case III was one of "copy-book" duodenal ulcer; typical pain, food relief and acidity. Again, the pain was absent during active hunger contractions and occurred with the cessation of these contractions. In this case, again, the position of the patient seemed to influence the pain. It began while the patient lay upon his right side (low gastric tonus, no contractions), ceased at once on turning upon the left side (hunger contractions began), and when the patient turned back to the right side the pain soon became continuous (low tonus, no contractions).

The relation of pain to motility of Cases II and III was strikingly alike, though the nature and situation of the pain was quite different, and one might have expected that the lesions would have had some points in common. However, one was a penetrating gastric ulcer adherent to the pancreas and the other was a duodenal ulcer, almost reactionless and unusually free from adhesion of any sort; in fact, the duodenum was so mobile that a Finney pyloroplasty was easily performed. It seemed in Case II (the gastric ulcer) that the obvious involvement of the base of the large intestine must have been concerned with the pain, especially since relief was coincident with the passage of flatus by the rectum. The same mechanism cannot be invoked in the duodenal ulcer.

Carlson suggests that when no gastric contraction is found to coincide with pain that the pain is likely to have originated in pyloric spasm reflex upon the passage of acid gastric contents into the duodenum. There is nothing in these studies to confirm or disprove such an hypothesis. There is evidence, however, that, even in the presence of an active ulcer far removed from the pylorus, powerful contractions of the fundus may cause no pain, and pain may occur independently of any muscular activity of the fundus.

ANATOMIC POINTS DETERMINING THE DIRECTION OF THE NEEDLE AND THE PROPER ROUTE FOR LUMBAR PUNCTURE IN CHILDREN AND ADULTS.

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Upon consulting the voluminous literature on rachientesis, one is immediately impressed by a certain diversity of opinion as to many of the essential points of the technic. There appears to be in general a tendency to treat lightly the details of the procedure, despite the fact that it is these apparently minor points of technic that are so important in bringing about a successful result. This is more especially the case because lumbar puncture is a "blind" operation and is guided mostly by the sensation of touch, and success depends in no small measure on the correct site of introduction and direction of the needle.

During the 1916 epidemic of poliomyelitis, and subsequent to that time we were privileged to perform or supervise the operation in over 1000 lumbar punctures in all varieties of meningeal conditions, and for both diagnostic and therapeutic purposes. Clinically, we were impressed by certain points relative to the technic which seemed to facilitate the puncture and which rendered dry taps an unusual, indeed almost rare, complication. It is our present purpose to speak of two of these points, one relative to the route for puncture and the other concerning the direction of the needle.

The conclusions ultimately drawn were made first on the living subject and were later confirmed by studies in the dissecting room on the cadaver.

The Route for Puncture in Children. There exists some divergence of opinion among authors as to the route to be employed in young patients. Most authorities, however, seem to concede that the median route is most advantageous. Anyone who has performed a number of punctures, using the median route, must certainly be impressed by its simplicity in children.

There are several reasons for the superiority of this route over the lateral: The spinous process of the lumbar vertebræ in young